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REMARKS

Applicant concurrently files herewith a Petition and fee for a One-month Extension of Time.

Claims 15-27 and 56-75 are all the claims presently being examined in the application. Non-elected claims 1-14 and 28-55 have been canceled above. New claims 60-75 have been added to more completely define the invention. Claims 15-27, 56, 57 and 59 stand rejected on prior art grounds.

With respect to the prior art rejections, claims 15-16, 19-20, 27 and 56 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Guenzer (U.S. Patent No. 5,478,653). Claims 15 and 27 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Wilk et al. (U.S. Patent No. 6,248,621). Claims 17-18 and 57 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Guenzer in view of Setsune et al. (U.S. Patent No. 4,980,339). Claims 21-22 and 25-26 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Guenzer in view of Reisman et al. (U.S. Patent No. 4,891,329). Claims 23-24 and 59 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Guenzer in view of Reisman et al. and further in view of Setsune et al.

These rejections are respectfully traversed in view of the following discussion.

It is noted that the claim amendments herein are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims, or for any statutory requirements of patentability.

Further, it is noted that, notwithstanding any claim amendments made herein, Applicant's intent is to encompass equivalents of all claim elements, even if amended herein or later during prosecution.

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I. THE CLAIMED INVENTION

Applicant's invention, as disclosed and claimed (e.g., see independent claim 1), is directed to semiconductor structure, which includes a substrate, a crystalline oxide layer formed over the substrate, and an epitaxial silicon layer formed on the crystalline oxide layer.

In another aspect of the invention, as defined by independent claim 21, a semiconductor structure, includes a substrate, a crystalline oxide layer formed over the substrate, and an epitaxial germanium layer formed on the crystalline oxide layer.

In yet another aspect of the invention, as defined by independent claim 27, a semiconductor structure, includes a crystalline oxide surface, and an amorphous layer of at least one of silicon, germanium, gallium arsenide, aluminum arsenide, indium phosphide, aluminum antimonide, indium arsenide, gallium phosphide and mixed alloys thereof, deposited on the crystalline oxide surface by evaporation or chemical vapor deposition.

With the unique and unobvious structure of the invention, a lattice-matched (e.g., epitaxial in an exemplary embodiment) insulator-silicon structure can be formed on silicon, which is substantially defect-free and uniform. Further, the invention provides lattice-matched epitaxial insulator-germanium structures.

Such features are not taught or suggested by any of the prior art of record.

II. THE PRIOR ART REJECTIONS

As described below, the claimed invention clearly differs from Guenzer, Wilk et al., Setsune, and/or Reisman, either alone or in combination (arguendo).

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Applicant respectfully submits that the Examiner has misinterpreted the cited passages of Guenzer and Wilk et al., and the secondary references, as discussed below. Thus, the claimed invention is patentable over all of the prior art of record, as discussed below.

A. The Guenzer Reference

Guenzer et al. discloses a bismuth titanate as a template layer for growth of crystallographically-oriented silicon. However, Guenzer is completely irrelevant to the claimed invention.

First, while the Examiner's keyword search may have uncovered some similar terms used in the claims of the present application, the structure of Guenzer is completely different from the claimed invention, and thus Guenzer fails to teach or suggest the claimed invention.

That is, regarding the Examiner's comment No. 3 (e.g., see page 2 of the Office Action), the Examiner misinterprets Guenzer's teaching. Specifically, the Examiner asserts that Guenzer discloses the deposition of a crystalline oxide over a silicon substrate.

However, looking closely at Fig. 2 of Guenzer, and at col. 3 lines 20-21, col. 2 line 30-31 of Guenzer, the crystalline oxide is grown on top of an amorphous silica layer (e.g., BTO layer 12) (col. 2 line 30-31) which in turn is grown on the silicon substrate (see Fig. 2 and this is clearly mentioned in Guenzer's disclosure). This is contrary to new dependent claims 60-62 in which the crystalline oxide is grown directly on the substrate.

Hence, in Guenzer, the crystalline oxide is never grown on the silicon substrate directly and, indeed, Guenzer's method is about growing oriented silicon over a non-crystalline substrate (e.g., see, for example, Summary of invention of Guenzer col. 2

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lines 5-10; also see col. 4, lines 12-15). Thus, Guenzer fails to teach or suggest new dependent claims 60-62 which define the crystalline oxide grown directly on the substrate.

Secondly, Guenzer's non-crystalline substrate is the amorphous silica layer (e.g., BTO layer 12) (col. 2, lines 30-32) which may be dispersed over a silicon substrate. Guenzer's "oriented silicon" is not single crystal, epitaxial silicon, as defined by new dependent claim 63 etc.).

Instead, Guenzer's "oriented silicon" is an oriented polycrystalline film (clearly described in col. 1, lines 57-65), thereby resulting in two-dimensional crystallites (col. 1, line 65). The underlying oxide (BTO) of Guenzer is also oriented polycrystalline (see col. 1, lines 50-57) and is technically polycrystalline with a fiber texture rather than single crystal in nature.

Therefore, Guenzer teaches a material which is completely different from that of the invention in that:

(a) the invention's overgrown silicon is epitaxial (e.g., as defined by independent claim 15) and single crystal (e.g., as defined by new dependent claim 62);

(b) the invention's underlying oxide is also epitaxial and single crystal (e.g., as defined by new dependent claims 65-70); and

c) the invention preferably grows out oxide directly on the substrate (e.g., as defined by new dependent claims 60-62). In contrast, Guenzer discloses an amorphous silica layer which may be either free-standing or dispersed on a silicon wafer.

Thus, in view of the foregoing, claims 15-16, 19-20, 27 and 56 are patentable over the teachings of Guenzer.

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B. The Wilk et al. Reference

Regarding the Examiner's comment No. 5 on page 4 of the Office Action and the rejection of claims 15 and 27, there are clear differences between Wilk's embodiment and the claimed invention.

Indeed, Wilk specifically restricts his oxide layers to being of the perovskite crystal structure (e.g., of what calcium strontium titanate and barium strontium titanate consist) (col. 3, lines 45-40, and col. 4, lines 10-20). Wilk also describes a (100) silicon orientation.

In complete and fundamental contrast, the oxide material of the claimed invention (e.g., as defined by new dependent claims 71-73) is very different from a perovskite oxide, and crystallizes with the bixbyite structure. Such a difference is important since the calcium-containing titanates of Wilk et al. are much more reactive and have poor electrical properties. The inventive oxide material is quite different.

Another key difference is that, in contrast to the recitations of new dependent claims 74-75, Wilk's crystalline oxide cannot be exactly lattice-matched to silicon. That is, Applicant points out Wilk's usage of the phrase "substantially matched" (e.g., see Col. 4, lines 18-20).

Regarding claim 27 (e.g., see bottom of page 4 of the Office Action), the Examiner indicates that "Wilk teaches...a crystalline oxide surface 5; and an amorphous silicon layer 7 that is deposited on the crystalline oxide surface...."

However, Applicant respectfully submits that the Examiner's reasoning and position are erroneous.

That is, the silicon layer 7 is single crystal epitaxial (and not amorphous as defined by independent claim 27) since according to Wilk et al., col. 3, lines 47-49, which discloses that

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"a layer of silicon 7 is then epitaxially deposited over the crystalline perovskite layer 5, this layer being crystalline in form since the layer 5 thereunder is". Wilk clearly states here that layer 7, which is silicon is epitaxial and crystalline. Therefore, such a layer cannot be amorphous as the Examiner contends.

Perhaps, the Examiner is confusing this with layer 9 of Wilk in Fig. 2 which is an amorphous silicon oxide. However, the silicon oxide will always remain amorphous and will not be converted into crystalline form. It is therefore quite different than the amorphous layers that the invention deposits, which are amorphous only in a metastable state, and which are converted by the invention to a crystalline form by thermal treatment.

Thus, in view of the foregoing, claims 15 and 27 are patentable over the teachings of Wilk et al.

C. The Setsune Reference

Regarding the rejection of claims 17-18 and 57, the deficiencies of Guenzer have been discussed above. Setsune fails to make up for such deficiencies.

Indeed, regarding the Examiner's comments in Item No. 7 and claims 17-18 and 57, again Guenzer discloses something totally different from the claim invention.

That is, Guenzer discloses an amorphous silica layer grown over silicon, then a polycrystalline, oriented (or textured) oxide with two dimensional crystallites grown on top of this. This structure has no bearing or relevance on the claimed structure which is single crystal (e.g., as defined by new dependent claims 63-64), epitaxial (e.g., as defined by independent claim 15) and therefore is completely different.

Guenzer therefore does not teach "substantially the entire claimed structure".

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Moreover, even assuming arguendo that Setsune would have been combined with Guenzer, using Setsune's teachings with Guenzer's technique therefore would lead one of ordinary skill in the art to a polycrystalline structure which is quite different from what the invention achieves.

Furthermore, Setsune discloses mixing either Ba, Sr, Ca, Be, Mg or ZrO_2 with a rare earth. These result in very different materials from those of the present invention, as defined by dependent claims 17-18 and 57 (which comprise two rare earths), and which as defined by new dependent claims 71-73 crystallize with a bixbyite phase).

Indeed, following the Examiner's reasoning, it would be akin to saying that H_2O and SiO_2 are pretty much the same, since both contain oxygen!

Clearly, this is incorrect and nonsensical, and clearly the materials of Setsune and/or Guenzer do not teach or suggest the structure of the claimed invention defined by claims 17-18 and 57.

Mixed oxides with the perovskite structure do not render obvious a ternary rare earth oxide whose lattice constant can be made to match silicon. Additionally, a key feature of the claimed invention (as defined by new dependent claims 74-75) is to provide a material whose lattice constant matches Si. There is absolutely no recognition of this by either Guenzer or Setsune.

Thus, in view of the foregoing, claims 17-18 and 57 are patentable over the teachings of Guenzer in view of Setsune et al.

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D. The Reisman Reference

Regarding the rejection of claims 21-22 and 25-26, the deficiencies of Guenzer have been discussed above. Reisman fails to make up for such deficiencies.

Specially, regarding claims 21-22 and 25-26 and the Examiner's comments in Item No. 8, again Applicant respectfully submits that the Examiner's comments and reasoning are erroneous.

That is, the Examiner indicates that Guenzer teaches growing an "epitaxial silicon layer 14 formed on the crystalline oxide layer". However, the Examiner misinterprets the disclosure in Col. 3, lines 20-25.

That is, Guenzer discloses a silicon substrate on which epitaxial silicon layers are grown. The amorphous silica layer (e.g., BTO) is then grown on top of this epitaxial silicon layer, followed by the growth of the oriented polycrystalline oxide, followed by the growth of oriented silicon on top of it which will not be single crystalline in nature.

Neither Setsune et al. nor Reisman et al. remedies this deficiency of Guenzer.

In sum, Applicant respectfully submit that the Examiner's comments come from completely misinterpreting the Guenzer, Setsune, and Reisman references, and confusing single crystal material with oriented polycrystallites, and also confusing bixbyite structured materials with perovskites.

Thus, in view of the foregoing, claims 21-22 and 25-26 are patentable over the teachings of Guenzer in view of Reisman et al.

Further, claims 23-24 and 59 are patentable over the Examiner's urged combination of Guenzer, Reisman et al., and Setsune et al.

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Hence, turning to the clear language of independent claim 15 (independent claim 21 being patentable for similar and/or other reasons as discussed above), there is no teaching or suggestion of “*[a] semiconductor structure, comprising:*

a substrate;

a crystalline oxide layer formed over said substrate; and

an epitaxial silicon layer formed on said crystalline oxide layer” (emphasis Applicant’s).

As mentioned above, independent claim 21 is patentable for similar and/or other reasons as discussed above.

Further, there is no teaching or suggestion of independent claim 27 which recites “*[a] semiconductor structure, including:*

a crystalline oxide surface; and

an amorphous layer of at least one of silicon, germanium, gallium arsenide, aluminum arsenide, indium phosphide, aluminum antimonide, indium arsenide, gallium phosphide and mixed alloys thereof, deposited on said crystalline oxide surface by evaporation or chemical vapor deposition (emphasis Applicant’s).

For the reasons stated above, the claimed invention is fully patentable over the cited references.

Further, the other prior art of record has been reviewed, but it too, even in combination with Guenzer, Wilk et al., Setsune, and /or Reisman, fails to teach or suggest the claimed invention.

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III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 15-27 and 56-75, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

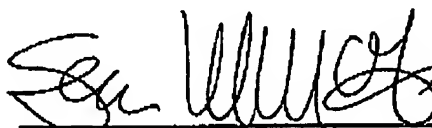
Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Assignee's Deposit Account No. 50-0510.

Respectfully Submitted,

Date:

7/31/03



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CERTIFICATION OF FACSIMILE TRANSMISSION

I hereby certify that I am filing this paper via facsimile, to Group Art Unit 2814, at
(703) 308-7722, on July 31, 2003.

Respectfully Submitted,

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